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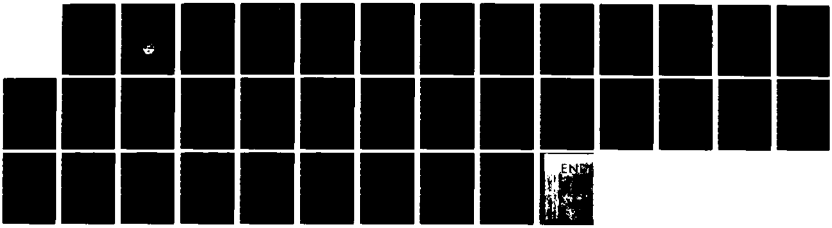

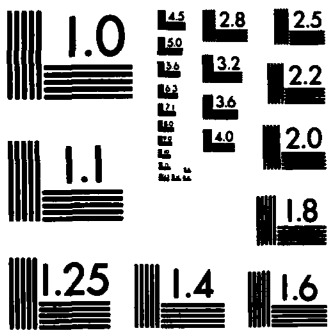

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METHODS TO IMPROVE TASK INVENTORY CONSTRUCTION

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METHODS TO IMPROVE TASK INVENTORY CONSTRUCTION

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Job task inventories that contain task statements that overlap as to content and that are not well organized by duty areas can lead to faulty analysis and misleading results. This study examined the statistical independence of task statements in two enlisted and two officer job specialities to improve inventory design. Statistical independence was assessed using correlational, factor, and cluster analyses. Results indicated that task statements often were not statistically independent, particularly in equipment-oriented job specialities and at the lowest and highest pay grades.

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Information on item independence can be used to (1) combine items and, thus, shorten inventories, (2) identify poorly written items, and (3) form blocks of related items for ease of inventory completion and analysis.

FOREWORD

This research was conducted in support of exploratory development work unit ZF63-521-001-030-03.07 (Job Task Measures for Classification) and was sponsored by the Chief of Naval Operations (OP-01). The objective of the work unit is to develop methods to provide linkage among (1) job task requirements, (2) aptitude and noncognitive attributes, and (3) technical school training content.

This report describes part of the work associated with the first objective--developing procedures to select criterion tasks for job task requirements. Task inventories administered to various occupational specialities often provide the best source of information about job content but have some weaknesses in their construction. Task statements that do not describe unique parts of the job (i.e., are not statistically independent) hamper the selection of representative criterion tasks. The effort described herein focuses on applying statistical methods to improve the uniqueness of inventory task statements, a preliminary but critical consideration.

Results of this research are intended for use by federal job analysts in military and civilian agencies.

J. W. RENARD
Commanding Officer

JAMES W. TWEEDDALE
Technical Director

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SUMMARY

Problem

Requiring large numbers of job incumbents in Navy occupational specialties (ratings) to complete lengthy job task inventories places heavy time demands on the fleet. Inventories containing task statements that do not describe unique parts of the job and that are not well organized by duty areas can lead to faulty analysis and misleading results. Such results impair efforts to structure jobs, validate classification tests, and specify skill and training requirements. More effective methods are needed to construct task statements and to organize inventories so that administration time will be minimized and useful data will be collected.

Objectives

The objectives of the research reported here were to evaluate methods to:

1. Improve the uniqueness (i.e., statistical independence) of task statements.

2. Reduce the overall length of occupational task inventories.

3. Design task statements for equipment systems or components.

4. Organize inventories into very specific duty categories and blocks of related task statements.

Approach

As part of its routine job analysis program, the Navy Occupational Development and Analysis Center (NODAC) collected job incumbent profiles for two enlisted ratings (electronics technician (ET) (N = 250) and yeoman (YN) (N = 250)), one unrestricted line officer community (special warfare officer (SPECWAR) (N = 165)), and one staff corps community (chaplain (CHC) (N = 668)). Analyses were performed on the relative time spent by incumbents on each task in the profiles. Statistical independence of tasks was assessed using (1) Pearson product-moment correlations, (2) factor analysis with principal axis factoring with iterations and oblique rotations, and (3) cluster analysis using an average linkage procedure.

Results

Correlational analysis indicated that task statements, particularly those from equipment-intensive duty categories, often lack statistical independence; that is, clusters of highly intercorrelated tasks were evident throughout various duty categories. Incumbents who performed any task in a cluster tended to perform all tasks in that cluster, devoting about the same time to each. Respondents' pay grade affected task relationships: Intercorrelations were generally highest among supervisors, moderate among apprentices, and lowest for journeyworkers.

Similarly, factor analysis indicated that, within equipment-intensive duty categories, tasks tended to load predominantly on a factor associated with a particular system or component. Task statements that loaded highly on the same factor illustrated a lack of uniqueness among tasks. Cluster analysis also revealed the lack of statistical independence among tasks, with high similarity values for tasks in various clusters. In

equipment-intensive duty areas, individual clusters focused on separate systems or components.

Conclusions

1. Task statements in job task inventories are often not statistically independent, particularly for equipment-intensive duty categories.

2. Highly correlated task statements, or subtasks, can be combined to form more inclusive, broader tasks. This procedure would simplify analysis and reduce administration material and time.

3. Because respondents' pay grade and type of work center can affect task relationships with each other, these variables must be considered when restructuring task statements.

4. The statistical methods demonstrated in this research are useful for forming blocks of intercorrelated tasks and identifying task statements that are poorly written or sequenced.

Recommendations

It is recommended that military occupational analysts and others responsible for constructing task inventories of several hundred statements do the following:

1. Use the statistical methods demonstrated in this research to assess the uniqueness (statistical independence) of task statements.

2. To reduce the length of future occupational inventories, use the methods developed and demonstrated in this research to combine tasks into fewer, broader tasks or to eliminate unnecessary statements.

3. Where applicable, especially in equipment-intensive ratings, use one task statement for each system or component.

4. Use factor analysis or cluster analysis to develop labeled blocks of intercorrelated tasks and to form shorter, more specific duty categories.

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INTRODUCTION

Background and Problem

The military services perform occupational analysis routinely on both enlisted and officer job specialties to provide data for a variety of personnel functions, including structuring jobs, developing and validating classification tests, and determining training requirements. This analysis begins with the administration of occupational surveys, or job task inventories, to large representative samples of job incumbents. The inventories contain several hundred task statements grouped into "duty categories" or major subdivisions of work, each of which focuses on performance of tasks in one functional area.

Inventories ask respondents to indicate the amount of time they spend performing each task in their present jobs. A basic analysis is calculation of "percentage of members performing"; that is, the number of individuals in the sample who perform a given task. A more frequently calculated measure, "relative-time-spent," compares the time spent performing a task to that spent on all other tasks performed by the incumbent. Time-spent values are also summed across all tasks within a duty category to calculate the percentage of job incumbents' time devoted to tasks in that category.

An important assumption of occupational inventories is that the content of each task statement is exclusive of the others. Although performance of a given task is assumed to be completely independent of performance on all other tasks, task statements may not always prove to be independent. For example, if two or more tasks are always performed together, they may be operating as subtasks, in which case they should be combined to form a broader, more inclusive task. Also, if two tasks are not clearly distinguished from one another, they may be confused by the respondents, who may say they perform both when, in fact, they perform only one. Finally, two tasks may be genuinely unrelated to each other but highly correlated because they are always performed by the same people.

Inventory task statements that overlap (i.e., are not mutually exclusive) pose serious problems in analyzing and interpreting occupational data. In data analysis, mutual dependency among tasks affects the calculation of relative-time-spent per duty category. Statements that are not mutually exclusive falsely inflate the time-spent index for duty categories by summing values for subtasks associated with performance of a broader task. Therefore, relative-time-spent will be overestimated for duty categories in which mutual dependency is prevalent.

Another weakness of intercorrelated task statements is that they artificially lengthen the occupational inventories. Indeed, perhaps the greatest criticism of the survey approach to job analysis concerns the extreme length and redundancy of inventories. The assumption that respondents are capable of giving acccurate, carefully considered responses to as many as 1000 statements is questionable at best. In addition, because surveys sometimes require in excess of 4 hours to complete, fatigue and boredom may lead to inaccuracies (Kishi, 1976). Mutually dependent tasks require responses to many more statements than would be necessary if tasks were independent. Shortening surveys by combining intercorrelated task statements would not only reduce administration time and cost, but would also hold some promise for obtaining more useful data.

The information garnered from investigating relationships among job task statements can be employed to improve the content, format, and organization of occupational inventories. Currently, few established guidelines exist for the construction of inventories. For instance, sequencing and grouping of statements are typically left to the

discretion of the task analysis team, with strategies ranging from (1) complete randomization, (2) organization by duty areas, and (3) an alphabetical listing of tasks (Kishi, 1976). Kishi recommends an untested procedure in which decisions for arranging task statements are based on an occupation's hardware and software orientation, as well as the existence of specialized or generalized duty areas.

Some inventories group task statements into homogeneous content areas designated as "blocks." Duty categories may consist of several independent blocks of tasks in which each block focuses on a specific component, system objective, or procedure. When blocks are labeled consistently and accurately, respondents can skip over blocks of task statements that are not applicable to work currently being performed. Conversely, one danger in blocking is that respondents may accidentally ignore tasks they actually perform when blocks are poorly labeled or are not homogeneous in content. However, the potential savings in time and improved quality of information when tasks are blocked rather than presented in a long list makes the blocking technique worthy of further investigation (Ramsey-Klee, 1981).

Goodgame (1981) advocates the formation of short, highly specific content blocks to facilitate data analysis and interpretation. Consistent with this approach, promising results have been achieved for a variety of personnel needs by grouping related tasks into independent "duty modules" (Cory, Johnson, Korotkin, & Stephenson, 1979; Duffy, 1976; Korotkin, Hadley, Davis, & Marsh, 1976).

A primary tool for occupational classification is the aptitude test, such as the Armed Services Vocational Aptitude Battery and its Navy predecessor, the Basic Test Battery. These tests have been demonstrated to be valid for predicting performance in formal technical training but seldom for predicting performance on the job. Improved job descriptions are needed, particularly in the area of the most difficult tasks, to develop criteria for predicting job performance. Unless job descriptions can adequately distinguish among unique parts of the job and among tasks of varying difficulty, better prediction may not be achieved.

Completion of lengthy job task inventories by large numbers of Navy job incumbents places heavy time demands on the fleet. Inventories constructed with tasks that do not describe unique parts of the job and that are not well organized by duty areas can lead to faulty analysis and misleading results. Such results may seriously impair measurement activities to structure jobs, to specify skill and training requirements, and to validate classification tests. Thus, more effective methods are needed to construct task statements and to organize task inventories so that administration time will be minimized and useful data will be produced.

Objectives

The objectives of the research reported here were to evaluate methods to:

1. Improve the uniqueness (i.e., statistical independence) of task statements.

2. Reduce the overall length of occupational task inventories.

3. Design task statements for equipment systems or components.

4. Organize inventories into very specific duty categories and blocks of related task statements.

APPROACH

Sample

As part of its routine job analysis program, the Navy Occupational Development and Analysis Center (NODAC) collected job incumbent profiles for incumbents of two enlisted ratings (electronics technician (ET) and yeoman (YN)), one unrestricted line officer community (special warfare officer (SPECWAR)), and one staff corps officer community (chaplain (CHC)). These specialties were selected for the present research because their work functions were quite diverse. Specifically, ETs and SPECWARs deal primarily with work of a technical nature, while YNs and CHCs emphasize nontechnical service functions. Sample sizes were 250 ETs, 250 YNs, 165 SPECWARs, and 668 CHCs. The ET and YN samples, which represented randomly selected subsets of much larger data sets, were used to reduce computing costs after preliminary analysis of both the subsets and the entire data sets produced highly similar results.

Analyses were performed on the relative-time-spent by incumbents on each task. When completing job task inventories, the ET and YN samples had indicated the relative-time-spent on each task using a 5-point scale, where 1 = very little and 5 = very much; and the SPECWAR and CHC samples, a 7-point scale, where 1 = very little and 7 = very much. For tasks not performed on the job, respondents were instructed to leave the response blank. Blanks were treated as zeros in all further analyses.

The number of task statements per inventory was 597 for ET, 529 for YN, 447 for SPECWAR, and 372 for CHC. Task statements were organized in a sequence of duty categories (e.g., administration, training, general military duties), but not labeled as such in the task inventories. Thus, the categories were not explicitly presented to the respondents.

Analyses

Correlational Analysis

Correlation matrices were produced for items within each duty category or group of duty categories in each sample. Correlational relationships were expressed as Pearson product-moment correlations. For the ET and YN samples, additional matrices were derived for each of three pay-grade groups (apprentice, E-1--E-4; journeyworker, E-5--E-6; and supervisor, E-7--E-9) to determine to what extent an incumbent's pay grade affected task relationships with each other.

Because tasks that are not performed receive zero scores, the presence of many zero-zero pairs for tasks performed by only a few people may substantially change the correlations, often artificially inflating them. To eliminate this effect, specific groups of task statements with high intercorrelations were examined further. Intercorrelations among these tasks were calculated, eliminating all respondents who did not perform at least one task in the group (cluster). Subsequent high intercorrelations among these groups would indicate not ony a strong relationship between performing one task and another, but also a strong similarity in the relative-time-spent on each.

An alternative to the correlational approach of assessing relationships among task statements involved counting the number of respondents who answered each task identically within a cluster. As in the previous procedure, only incumbents who indicated that they presently performed at least one of the items in the cluster were included in the analysis. The measure of similarity among statements simply consisted of counting the incumbents who responded identically to tasks in a designated cluster.

Factor Analysis

Several duty categories from each sample were factor analyzed using the principal axis factoring program with iterations included in the Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975). Because it was reasonable to assume that factors would be correlated, oblique rotations were used. The oblique rotation procedure produced two output matrices: a pattern matrix and a structure matrix. In this instance, the structure matrix was used because it included both the direct and indirect contributions of individual tasks to the factors.

The factors identified sets of statements with high intercorrelations and low correlations with other tasks; that is, task statements that received similar responses. The goodness of the factor solution, as indicated by traditional measures (Gorsuch, 1974, p. 182), is an index of the internal consistency of the task groups that make up the factors and, thus, the extent to which blocking of tasks would be beneficial.

Cluster Analysis

The Biomedical Computer Programs (BMDP) (Dixon & Brown, 1979) program for cluster analysis of variables (as opposed to the more common clustering of subjects) was applied to several duty categories from each sample. An average linkage procedure was selected that formed clusters based on the arithmetic average of similarity using all possible pairing of variables between two clusters. The output consisted of a summary table tracing formation of clusters, a matrix summarizing similarity among variables, and a tree diagram (of horizontal and diagonal dashed lines) overlaid on the matrix to illustrate the clustering process. These outputs are described in greater detail in the appendix.

RESULTS

Correlation Matrices

In general, intercorrelations for the first 10 tasks in the ET training duty category were moderate (median $r = .47$) and were representative of the relationships among statements established for the majority of the duty categories analyzed (see Table 1).[1] This finding indicated that tasks were associated but not necessarily to the extent of mutual dependency.

In contrast, correlation matrices produced for some duty categories permitted identification of groups or clusters of tasks, as evidenced by high intercorrelations. In many instances, correlations among a group of tasks consistently exceeded .90, as in Tasks 5 through 11 in the SPECWAR diving duty category (see Table 2). The size of the correlations indicates that all tasks in the cluster are highly associated. In almost every instance, if one task was performed by an incumbent, all other tasks in the cluster were performed as well.

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[1]Because of the large number of tables in this section relative to the amount of text, the tables are placed at the end of the section, commencing on page 7.

Table 3 presents correlations for the six tasks included in the ET electronic countermeasures/electronic support measures (ECM/ESM) equipment maintenance duty category. Although not as exceptionally high as those in Table 2, the correlations again suggest that tasks were dependent to a large extent. Duty categories characterized by tasks that focused on specific job-related equipment had correlation matrices yielding well-defined clusters. These matrices indicate that the duty categories generally included four- to five-task statement clusters, with each cluster focusing on a specific system or component. Responses differed so little from task to task that no new information was realized beyond the first statement in a cluster.

The eight equipment-oriented clusters extracted from the correlation matrix created for the ET radar equipment maintenance duty category are summarized in Table 4. Each cluster contains tasks pertaining to a particular system of radar equipment. The mean correlation within clusters is quite high, with values ranging from .90 to 1.0. The exceedingly high correlations again suggest that an incumbent who performed one task in a cluster was likely to perform the others, with about the same relative time spent on each.

To ascertain whether the structure of task clusters varied with level of job experience, additional correlation matrices were produced for several duty categories in the ET and YN occupations, following division of each sample into three pay-grade groups. For the most part, pay grade had no affect on the correlations among task statements. However, a few exceptions to this general finding did occur. For example, the correlations among six selected tasks from the YN legal duty category for each pay-grade group (summarized in Table 5) illustrated the impact of job level on the formation of clusters; that is, relationships among tasks became apparent in correlation matrices for one pay-grade group but not in the total sample or other pay grades. In general, correlations were highest for supervisors (median $\underline{r}$ = .94), medium for apprentices (median $\underline{r}$ = .73), and lowest for journeyworkers (median $\underline{r}$ = .64). These results suggest that journeyworkers may be the most specialized in their tasks, with apprentices assisting at and supervisors overseeing a greater variety of tasks. Certainly, such findings have important implications for the creation of specialties within ratings.

To remove the effect of numerous zero-zero pairs, correlation matrices were recalculated for clusters of highly related items, based only on the incumbents performing any of the tasks in the cluster. The matrices displayed in Tables 6 and 7 are examples of the results obtained. Table 6 presents correlations for the cluster that was presented in Table 2; and Table 7, for the cluster presented in Table 3. Comparison of the four corresponding tables indicates that task intercorrelations were not substantially reduced by removing zero-paired scores and suggests that most of the relationship among tasks was attributable to incumbents responding similarly to all statements in the cluster. Even in Table 7, in which the average drop in correlation from removal of zero-paired scores was .18, Tasks 3 and 4 correlated .97.

An alternative approach to examining overlap among tasks is illustrated in Table 8, which presents the percentage of incumbents responding identically to all tasks in eight selected clusters. These particular clusters, two from each rating, were chosen because of the high intercorrelations among tasks in the correlation matrices. As shown, the number of persons responding similarly to all statements in the clusters is highly variable, with the percentage of incumbents responding identically to all tasks ranging from 8.2 to 67.6 percent. However, equipment or "hardware" content areas had by far the greatest percentage of identical response profiles. Respondents indicated not only that they performed all tasks in the cluster, but also that they spent the same relative amount of time performing each. A high proportion of similar responses to each task statement in a cluster suggests a lack of independence among those tasks.

Factor Analysis

The majority of duty categories analyzed produced factor solutions in which items tended to load moderately on all three factors, making extraction of clusters virtually impossible. The factor analysis of the YN personnel support--enlisted records duty category (see Table 9) is typical. The results suggest that tasks in this duty category are not limited to a few persons in a billet but may be performed by almost anyone in the rating.

In marked contrast, factor analysis of some other duty categories from the four samples proved valuable for elucidating the relationships among tasks. In these instances, well-defined factors were easily extracted because task statements loaded predominantly in one factor and marginally on the others. Item clusters were formed by grouping together tasks on the basis of their highest common factor loading. As with the correlation matrices, the equipment-oriented duty categories yielded the most clearly delineated factors.

For example, tasks in the SPECWAR diving duty category could be reduced to two factors that might be labeled "supervise diving equipment maintenance" and "supervise diving operations and training." As shown in Table 10, 12 of the 15 tasks could be placed into one of two clusters because they loaded highly on only one factor. The remaining three tasks were not as readily classified because they loaded moderately on both factors. The moderate correlation between the two factors, .46, suggests that incumbents who perform one set of the tasks often perform the other as well.

Table 11, summarizing factor analysis of the ET radar equipment maintenance duty category, presents even more conclusive evidence that this statistical approach has merit for identifying groups of tasks that receive similar responses from incumbents. All but 4 of the 44 tasks loaded .90 or higher on one factor. The factors identified by this structure matrix were identical to the eight equipment-centered clusters presented earlier in Table 4. Each factor represented a particular component or system in the radar equipment maintenance process.

Cluster Analysis

Table 12, summarizing the task clusters formed by cluster analyzing the SPECWAR training duty category, represents the results of clustering most duty catgories examined. (See appendix for procedures used in interpreting cluster analysis results.) In this instance, 42 tasks were separated into 11 clusters. (Two statements were excluded because they failed to meet clustering criteria.) The similarity among task statements in the clusters is fairly high, with median similarity values ranging from 75 to 85. Evaluation of tasks within the clusters indicated that some statements presented far apart in the inventory were highly correlated. This finding clearly suggests that some tasks in subsequent inventories should be resequenced.

Groups of tasks formed by cluster analysis of statements in the ET communication equipment maintenance duty category, as presented in Table 13, illustrate more distinctly a lack of independence among tasks. The 91 tasks were reduced to 19 tightly knit clusters, with only one task statement failing to meet inclusion criteria. The similarities among tasks within clusters were exceptionally high. Clearly, performance of one task in a cluster was associated with performance of all others. Again, the content of the tasks within each cluster focused on a particular type of system or component. These types of clusters are currently excellent candidates to be blocked in future inventories or to be replaced with single task statements.

Table 1

Correlations Among Tasks 1-10 in the ET Training Duty Category (N = 250)

Task	1	2	3	4	5	6	7	8	9	10
1. Prepare individual training records.	-	.91	.78	.40	.41	.52	.21	.52	.37	.33
2. Update individual training records.		-	.77	.44	.36	.49	.26	.53	.38	.36
3. Schedule training lectures.			-	.48	.31	.39	.29	.47	.30	.36
4. Review lesson guides (instructor guides) for accuracy/completeness.				-	.43	.42	.62	.54	.46	.68
5. Administer tests/examinations.					-	.82	.49	.41	.40	.73
6. Grade tests/examinations.						-	.48	.47	.48	.73
7. Write lesson guides (instructor guides).							-	.35	.44	.70
8. Prepare training reports.								-	.56	.54
9. Write training outlines.									-	.55
10. Sign off practical factors.										-

Table 2

Correlations Among Tasks 5-11 in the SPECWAR Diving Duty Category (N = 165)

Task	5	6	7	8	9	10	11
5. Supervise repair of swimmer delivery vehicle (SDV) subsystems.	-	.98	.96	.95	.90	.93	.94
6. Supervise adjustment of mechanical components of SDV.		-	.98	.98	.92	.95	.97
7. Supervise removal/replacement of mechanical components of SDV.			-	.98	.94	.95	.94
8. Supervise test inspection on electric components of SDV.				-	.96	.96	.95
9. Supervise removal/replacement of electric or electronic components of SDV.					-	.98	.95
10. Supervise removal/replacement of components of life support system of SDV.						-	.95
11. Supervise cleaning/changing/removal/replacement of SDV batteries.							-

Table 3

Correlations Among Tasks in the ET Electronic Countermeasures/ Electronic Support Measures (ECM/ESM) Equipment Maintenance Duty Category (N = 250)

Task	1	2	3	4	5	6
1. Remove/replace components of ECM/ESM equipment.	-	.83	.89	.89	.81	.81
2. Clean/lubricate components of ECM/ESM equipment.		-	.89	.90	.92	.85
3. Adjust/align ECM/ESM equipment.			-	.99	.93	.93
4. Test/inspect ECM/ESM equipment.				-	.94	.93
5. Troubleshoot ECM/ESM equipment to major component/subsystem.					-	.91
6. Troubleshoot ECM/ESM equipment/ subsystem to failed circuit part.						-

Table 4

Equipment-oriented Task Clusters Extracted from the ET Radar Equipment Maintenance Duty Category (N = 250)

Equipment-oriented Task Cluster	Number of Tasks	Mean Task Intercorrelation
1. Ground controlled approach (GCA)/carrier controlled approach (CGA) radar systems.	5	.97
2. Air search radar system.	5	.97
3. Surface search radar system.	5	.92
4. Weather radar.	5	1.00
5. Radar antenna motion system.	6	.90
6. Identification friend or foe (IFF) system.	5	.97
7. Radar signal distribution system.	6	.95
8. Radar indicators.	5	.93

Note. Item clusters represent 42 of 44 items in the duty category.

Table 5

Correlations Among Tasks 17-22 in the YN Legal Duty Category for Three Pay-grade Groups

Task	17	18	19	20	21	22
Apprentice (N = 102)						
17. Record nonjudicial punishment (NJP) at captain's mast.	-	.79	.70	.85	.71	.86
18. Type NJP service record entries as appropriate.		-	.60	.71	.60	.73
19. Notify personnel of captain's mast (such as accused, witness).			-	.80	.84	.70
20. Prepare/type confinement orders (NAVPERS 1523).				-	.81	.89
21. Prepare/type court-martial appointing orders.					-	.72
22. Advise accused of hearing/appellate rights.						-
Journeyworker (N = 113)						
17. Record NJP at captain's mast.	-	.76	.55	.67	.57	.64
18. Type NJP service record entries as appropriate.		-	.85	.81	.71	.62
19. Notify personnel of captain's mast (such as accused, witness).			-	.69	.74	.60
20. Prepare/type confinement orders (NAVPERS 1523).				-	.78	.51
21. Prepare/type court-martial appointing orders.					-	.50
22. Advise accused of hearing/appellate rights.						-
Supervisor (N = 35)						
17. Record NJP at captain's mast.	-	.99	.94	.99	.93	.86
18. Type NJP service record entries as appropriate.		-	.95	.98	.92	.85
19. Notify personnel of captain's mast (such as accused, witness).			-	.93	.88	.82
20. Prepare/type confinement orders (NAVPERS 1523).				-	.96	.92
21. Prepare/type court-martial appointing orders.					-	.99
22. Advise accused of hearing/appellate rights.						-

Table 6

Correlations Among Tasks in the SPECWAR Diving Duty Category for Incumbents Performing One or More of the Tasks (N = 18)

Task	5	6	7	8	9	10	11
5. Supervise repair of swimmer delivery vehicle (SDV) subsystems.	-	.97	.91	.90	.79	.86	.87
6. Supervise adjustment of mechanical components of SDV.		-	.96	.95	.85	.90	.93
7. Supervise removal/replacement of mechanical components of SDV.			-	.96	.89	.91	.88
8. Supervise test inspection on electric components of SDV.				-	.93	.93	.90
9. Supervise removal/replacement of electric or electronic components of SDV.					-	.97	.90
10. Supervise removal/replacement of components of life support system of SDV.						-	.90
11. Supervise cleaning/changing/removal/replacement of SDV batteries.							-

Table 7

Correlations Among Tasks in the ET ECM/ESM Equipment Maintenance Duty Category for Incumbents Performing One or More of the Tasks (N = 28)

Task	1	2	3	4	5	6
1. Remove/replace components of ECM/ESM equipment.	-	.58	.68	.68	.47	.49
2. Clean/lubricate components of ECM/ESM equipment.		-	.70	.73	.78	.61
3. Adjust/align ECM/ESM equipment.			-	.97	.77	.79
4. Test/inspect ECM/ESM equipment.				-	.80	.78
5. Troubleshoot ECM/ESM equipment to major component/subsystem.					-	.74
6. Troubleshoot ECM/ESM equipment/subsystem to failed circuit part.						-

Table 8

Percentage of Incumbents Responding Identically to all Tasks in Selected Task Clusters

Sample	Duty Category (Tasks)	Number of Tasks in the Cluster	Number of Respon-dents	Identical Response Profiles N	%
ET	Radar equipment maintenance (8-12)	5	34	23	67.6
SPECWAR	Diving (7-13)	7	17	10	58.8
ET	ECM/ESM equipment maintenance (1-6)	6	28	11	39.3
YN	Administration-general correspondence (51-54)	4	32	5	15.6
CHC	Counseling areas (22-26)	5	379	54	14.2
YN	Legal (17-22)	6	50	5	10.0
SPECWAR	Special warfare operations (32-37)	6	79	7	8.9
CHC	Family services (2-6)	5	354	29	8.2

Table 9

Task Factor Loadings for the YN Personnel Support--Enlisted Records Duty Category
(N = 250)

Task	Factors[a] 1	2	3
1. Open enlisted service record(s).	.419	--	--
2. Prepare/type immediate reenlistment contract (NAVPERS 1070/601) (p. 1).	.916	.389	.376
3. Prepare/type reenlistment contract (DD Form 4).	.650	.280	.395
4. Prepare/type agreement to extend enlistment (NAVPERS 1070/621) (p. 1A).	.914	.369	.523
5. Prepare/type assignment to and extension of active duty (NAVPERS 1070/622) (p. 1B)	.805	.354	.406
6. Prepare/type enlisted classification record (NAVPERS 601-3) (p. 3).	.645	.284	--
7. Prepare/type Navy occupational/training and awards history (NAVPERS 1070/604) (p. 4).	.763	.356	.572
8. Prepare/type history of assignments (NAVPERS 1070/605) (p. 5).	.753	.354	.518
9. Prepare/type record of unauthorized absence (NAVPERS 1070/606) (p. 6).	.402	.955	--
10. Prepare/type court memorandum (NAVPERS 1070/607) (p. 7).	.335	.881	--
11. Prepare/type enlisted performance record (NAVPERS 1070/609) (p. 9).	.596	.655	.543
12. Prepare/type record of personnel action (NAVPERS 1070/610) (p. 10).	.650	.508	.455
13. Prepare/type record of naval reserve service (NAVPERS 601-11) (p. 11).	.522	.281	--
14. Prepare/type transfer and receipts (NAVPERS 1070/612) (p. 12).	.746	.469	.498
15. Prepare/type administrative remarks (NAVPERS 1070/613) (p. 13).	.586	.705	.386
16. Prepare/type record of discharge, release from active duty, or death (NAVPERS 601-14/ NAVCOMPT 512) (p. 14).	.608	.343	.417
17. Prepare/type report of enlisted evaluation (NAVPERS 1616/5) (E-1--E-4).	.328	--	.699
18. Prepare/type first and second class petty officer evaluation report (NAVPERS 1616/18) (E-5--E-6).	.391	.273	.849
19. Prepare/type master, senior, chief petty officer evaluation report (NAVPERS 1616/8) (E-7--E-9).	.509	.328	.776
20. Prepare/maintain enlisted diary (NAVPERS 1070/75).	.669	--	.641
21. Prepare/type Navy enlisted classification code change recommendation (NAVPERS 1221/1).	.581	.357	.395
22. Verify enlisted distribution and verification report (NMP) (BUPERS Report 1081-14).	.638	--	.539
23. Prepare/type records transmittal (NAVPERS 5000/64).	.269	--	--

[a]Values below .25 have been excluded.

Table 10

Task Factor Loadings for the SPECWAR Diving Duty Category
(N = 165)

Task	Factor 1 (Supervise Diving Equipment Maintenance)	Factor 2 (Supervise Diving Operations and Training)
1. Schedule and coordinate unit training and requalification dives.	.335	.823
2. Maintain individual diving records.	.306	.840
3. Prepare and conduct diving operaions.	.316	.784
4. Perform the duties of a diving instructor.	.332	.709
5. Supervise repair of swimmer delivery vehicle (SDV) subsystems.	.962	.425
6. Supervise adjustment of mechanical components of SDV.	.984	.408
7. Supervise removal/replacement of mechanical components of SDV.	.982	.416
8. Supervise test inspection of electric or electronic components of SDV.	.989	.436
9. Supervise removal/replacement of electric or electronic components of SDV.	.969	.502
10. Supervise removal/replacement of components of life support system of SDV.	.979	.486
11. Supervise cleaning/changing/removal/replacement of SDV batteries.	.969	.465
12. Administer diving PQS for team members.	.644	.836
13. Conduct investigations and prepare reports concerning diving accidents.	.582	.776
14. Supervise maintenance/repair of HP air systems, banks, and compressors.	.519	.641
15. Supervise diving locker personnel.	.287	.779

Table 11

Task Factor Loadings for the ET Radar Equipment
Maintenance Duty Category
(N = 250)

Task	Factor[a]							
	1	2	3	4	5	6	7	8
1. Record own ship's radar parameters (such as VSWR, power out, PRF).	.491	.298	--	-.455	-.316	-.528	-.628	.448
2. Install/remove corner reflectors.	--	.561	--	-.319	-.258	--	--	--
3. Remove/replace components of ground controlled approach (GCA)/carrier controlled approach (CCA) radar systems.	.266	.954	--	--	-.320	--	-.373	--
4. Troubleshoot GCA/CCA radar systems to subsystems.	.261	.991	--	--	-.335	--	-.384	--
5. Troubleshoot GCA/CCA radar systems/ subsystems to failed circuit part.	.263	.992	--	--	-.338	--	-.387	--
6. Adjust/align GCA/CCA radar systems.	.260	.996	--	--	-.321	--	-.367	--
7. Test/inspect GCA/CCA radar systems components.	.252	.989	--	--	-.314	--	-.358	--
8. Remove/replace components of air search radar system.	.373	.353	--	-.435	-.974	-.435	-.469	.314
9. Adjust/align air search radar system.	.368	.320	--	-.402	-.993	-.437	-.471	.325
10. Troubleshoot air search radar system to subsystem.	.374	.329	--	-.415	-.997	-.446	-.484	.330
11. Troubleshoot air search radar system/ subsystem to failed circuit part.	.384	.332	--	-.434	-.991	-.455	-.475	.333
12. Test/inspect air search radar system.	.401	.309	--	-.400	-.952	-.482	-.516	.335
13. Remove/replace components of surface search radar system.	.670	--	--	-.407	-.353	-.443	-.477	.961
14. Adjust/align surface search radar system.	.682	--	--	-.444	-.286	-.457	-.531	.969
15. Troubleshoot surface search radar system to subsystem.	.702	--	--	-.472	-.298	-.467	-.499	.933
16. Troubleshoot surface search radar system/ subsystem to individual component.	.738	--	--	-.468	-.309	-.471	-.514	.965
17. Test/inspect surface search radar system.	.678	--	--	-.470	-.323	-.486	-.519	.964
18. Remove/replace components of weather radar.	--	--	.245	--	--	--	--	--
19. Adjust/align weather radar.	--	--	.998	--	--	--	--	--
20. Troubleshoot weather radar to major component.	--	--	.998	--	--	--	--	--
21. Troubleshoot weather radar to failed circuit part.	--	--	.998	--	--	--	--	--
22. Test/inspect weather radar.	--	--	.998	--	--	--	--	--
23. Remove/replace components of radar antenna motion system (rotate, scan, etc.).	.438	.265	--	-.925	-.382	-.515	-.404	.435
24. Adjust/align radar antenna motion system.	.491	--	--	-.976	-.424	-.474	-.406	.456
25. Clean/lubricate radar antenna motion system.	.472	--	--	-.891	-.318	-.517	-.358	.465
26. Test/inspect radar antenna motion system.	.495	--	--	-.953	-.378	-.517	-.410	.475
27. Troubleshoot radar antenna motion system to major component.	.469	.254	--	-.970	-.416	-.442	-.448	.435
28. Troubleshoot radar antenna motion system to failed circuit part.	.460	.258	--	-.953	-.406	-.448	-.452	.421
29. Remove/replace components of identification friend or foe (IFF) system.	.557	.364	--	-.426	-.452	-.554	-.978	.489
30. Troubleshoot IFF system to subsystem.	.573	.361	--	-.403	-.463	-.571	-.990	.502
31. Troubleshoot IFF system/subsystem to failed circuit part.	.571	.365	--	-.408	-.461	-.569	-.993	.498
32. Adjust/align components of IFF system.	.579	.370	--	-.392	-.459	-.572	-.971	.462
33. Test/inspect components of IFF system.	.574	.361	--	-.381	-.446	-.559	-.990	.498
34. Remove/replace components of radar signal distribution system (video amps, trigger amps, switchboards, etc.).	.554	.280	--	-.503	-.477	-.916	-.581	.467
35. Adjust/align radar signal distribution system.	.590	.258	--	-.474	-.403	-.988	-.601	.453
36. Clean radar signal distribution system.	.567	--	--	-.498	-.390	-.974	-.577	.447
37. Test/inspect radar signal distribution system.	.585	--	--	-.479	-.429	-.979	-.561	.455
38. Troubleshoot radar signal distribution system to subsystem.	.601	--	--	-.505	-.457	-.983	-.594	.481
39. Troubleshoot radar signal distribution system/subsystem to failed circuit part.	.611	--	--	-.474	-.485	-.982	-.581	.481
40. Remove/replace components of radar indicators.	.929	--	--	-.477	-.278	-.620	-.521	.721
41. Adjust/align radar indicators.	.962	.265	--	-.484	-.353	-.589	-.591	.682
42. Test/inspect radar indicators.	.982	.275	--	-.471	-.352	-.568	-.587	.684
43. Troubleshoot radar indicators to major component.	.989	.275	--	-.497	-.374	-.595	-.601	.680
44. Troubleshoot radar indicators to failed circuit part.	.954	--	--	-.481	-.364	-.567	-.587	.682

[a]Except for item 18, values below .25 have been excluded.

Table 12

Task Clusters Produced by Cluster Analyzing the SPECWAR Training Duty Category

Cluster	Number of Task in Cluster	Cluster Members[a]	Range of Similarity Values	Median
1	4	1, 2, 6, 7	73-82	80
2	5	3, 4, 5, 13, 36	74-93	84
3	4	27, 31, 33, 32	82-88	85
4	5	28, 29, 30, 37, 38	79-88	83
5	2	34, 35	85	85
6	3	11, 12, 14	75-83	77
7	3	15, 16, 26	75-76	75
8	2	8, 9	81	81
9	4	10, 39, 41, 42	71-82	78
10	2	17, 20	77	77
11	6	18, 21, 24, 25, 22, 23	70-85	82

[a]Items 19 and 40 did not meet clustering criteria.

Table 13

Task Clusters Produced by Cluster Analyzing the ET Communications Equipment Maintenance Duty Category

Cluster	Number of Task in Cluster	Cluster Members[a]	Range of Similarity Values	Median
1	3	1, 2, 3	94-96	96
2	5	51, 52, 53, 54, 55	95-98	97
3	5	56, 57, 58, 59, 60	95-99	97
4	6	61, 62, 63, 64, 65, 66	85-97	91
5	5	87, 88, 91, 89, 90	92-97	96
6	5	77, 78, 79, 80, 81	93-98	95
7	4	15, 16, 17, 18	90-96	93
8	5	32, 33, 34, 35, 36	85-94	90
9	4	42, 43, 44, 45	89-98	91
10	5	23, 24, 25, 26, 27	88-98	93
11	4	19, 20, 21, 22	81-92	87
12	5	72, 73, 74, 75, 76	93-99	97
13	7	4, 5, 6, 8, 7, 9, 10	88-95	93
14	4	11, 12, 13, 14	89-97	92
15	5	37, 38, 39, 40, 41	94-99	97
16	5	67, 68, 71, 70, 69	91-99	99
17	4	28, 29, 31, 30	99	99
18	5	82, 83, 84, 85, 86	89-97	93
19	4	47, 48, 49, 50	72-99	72

[a]Item 46 did not meet clustering criteria.

DISCUSSION

Lack of Statistical Independence Among Task Statements

Both correlation matrices and factor analytic solutions conclusively indicated that many duty categories consist of clusters of highly intercorrelated statements. Performance of any one task in a cluster was frequently associated with performance of all other tasks in the cluster. In the two technical occupations (ET and SPECWAR), these clusters most commonly occurred in the equipment-oriented duty categories. When people performed all tasks in the cluster, the action verbs in equipment-oriented task statements failed to discriminate among tasks. Thus, it appeared that the underlying assumption in task inventory method job analysis--independence or mutual exclusivity among task statements--was not met.

Minimizing Redundancy in Task Statements

Should each system or component have one task statement (operate), two (operate, maintain), three (operate, maintain, troubleshoot), four (operate, maintain, troubleshoot, repair), or more? The high correlations among statements in specific equipment clusters suggest that one task statement would often obtain the same amount of profile information as would multiple statements; simply, whether an incumbent operates or maintains a particular system or component. By reducing each cluster to one task statement, the length of an inventory could be substantially reduced (see Figure 1). More research is needed to address this issue.

Combining Task Statements

Results from the statistical analysis of many duty categories from each of the four occupations suggest that highly intercorrelated task statements may be combined into more inclusive, broader tasks without an associated loss of profile information. The broader tasks must be worded so that they summarize the performance of the separate tasks. For example, within the ET training duty category, "prepare individual training records" and "update individual training records" could be combined under "maintain individual training records" because these statements correlated .91. Combining task statements has the potential to minimize administration time, conserve financial and personnel resources, yield more reliable estimates of time spent in each duty category, improve the quality of responses, and simplify analyses.

Two precautions must be made in combining task statements, however. First, the decision cannot be made solely on statistical grounds but must involve the subject matter expert's (SME's) knowledge of the field. In some areas, one or two critical tasks that are highly correlated with a cluster may differentiate a subgroup having different critical requirements from that cluster. For example, a small number of electrical-mechanical personnel may occasionally disarm mines, as well as perform the other tasks in the cluster. This task is critical and may be the reason for special pay. An SME would retain these key task items; a statistical rule might not. An SME would also be able to identify tasks that are usually done together but that require different skills, such as "prepare fitness reports" and "counsel subordinates on their performance," and retain these as separate items, even though they are highly correlated.

Second, for some specific purposes, such as training, information about each item in the cluster may be required. A curriculum designer needs to know, for example, what procedures are involved in maintaining a piece of equipment and how much time is spent performing each. The high item intercorrelations suggest, however, that SMEs may be more appropriate sources of this detailed information than would incumbents.

	Inter-item Correlation	Revised Task Statement Format
		Maintain (remove/replace, adjust/align, troubleshoot, test/inspect):
436. Remove/replace components of air search radar system. 437. Adjust/align air search radar system. 438. Troubleshoot air search radar system to subsystem. 439. Troubleshoot air search radar system/subsystem to failed circuit part. 440. Test/inspect air search radar system.	.97	Air search radar system
457. Remove/replace components of identification friend or foe (IFF) system. 458. Troubleshoot IFF system to subsystem. 459. Troubleshoot IFF system/subsystem to failed circuit part. 460. Adjust/align components of IFF system 461. Test/inspect components of IFF system.	.97	Identification friend or foe (IFF) system
462. Remove/replace components of radar signal distribution system (video amps, trigger amps, switchboards, etc.). 463. Adjust/align radar signal distribution system. 464. Clean radar signal distribution system. 465. Test/inspect radar signal distribution system. 466. Troubleshoot radar signal distribution system to subsystem. 467. Troubleshoot radar signal distribution system/subsystem to failed circuit part.	.95	Radar signal distribution system

Figure 1. Demonstration of a method to reduce the number of task statements in a task inventory for the ET rating by combining highly correlated items.

Pay-grade and Work Center Differences

Separate analyses of the ET and YN data demonstrated that relationships among task statements often vary with the pay grade of respondents; that is, a cluster of highly intercorrelated tasks may exist for one pay grade and not for others. This type of information is vital because a critical prerequisite for combining task statements is that task performance be concomitant at all pay-grade levels.

The three levels of maintenance (organizational, intermediate, and depot) must also be given careful consideration in making decisions concerning specificity of tasks and possible strategies for their combination. For instance, working with line replaceable units at the organizational level must be clearly distinguished from performing overhauls on complete systems at the intermediate or depot level. Thus, preserving statements that are unique and that reflect differences in orientation of the various maintenance levels is critical. Given the trend toward remove/replace functions instead of repair at the organizational level, it will become increasingly important to distinguish between tasks performed at the organizational and intermediate levels. Task statements cannot be combined if such a procedure will obfuscate the three levels of maintenance.

Application of Factor Analysis

Factor analysis illustrated the advisability of blocking task statements within an inventory. Inventory developers can assume, for all practical purposes, that the item (task) factor loadings for equipment-oriented duty categories have already defined preliminary blocks of tasks, and they can use these loadings, paired with clear, consistent labeling, to form blocks that allow incumbents to skip quickly over groups of tasks not performed. Fairly short, homogeneous blocks of task statements minimize administration time and encourage respondents to provide more accurate, reliable responses.

Application of Cluster Analysis

Cluster analysis provides an alternative method for blocking interrelated tasks. This method is also available within the Comprehensive Occupational Data Analysis Programs (CODAP), the task analysis software used extensively by the military services. Because results using factor and cluster analyses were parallel, the choice between use of the two methods could be based on familiarity or ease of use.

The cluster formation sequence summarized by a tree diagram overlaid on the similarity matrix (see appendix) clearly illustrates potential blocking strategies in the form of various clusters. The failure of tasks to combine with any cluster may be due to a lack of relationship with other tasks in the duty category. Such statements should not be included in a block of tasks; rather, they should be presented individually.

In addition, cluster output has value for assessing the adequacy of item sequencing and for identifying poorly written tasks. Task statements are well sequenced if clusters contain tasks combined in approximately consecutive order. Marked aberrations from this pattern indicate that tasks need resequencing. A high correlation between two items should be a signal to examine the items to determine whether they are describing the same task, respondents are confusing the two tasks because the items are poorly written, or the two are subtasks of a third, more general task. The items can then be rewritten accordingly.

Formation of More Content-specific Duty Categories

Identifying the task statement relationships produced by cluster or factor analysis can contribute to the formation of shorter, more specialized duty categories advocated by both Goodgame (1981) and Ramsey-Klee (1981). CODAP previously limited the maximum number of duty categories to 26; however, an enhanced IBM version, CODAP System 80, has no such restrictions. Because System 80 accommodates as many duty categories as the analyst requires, duty categories can consist of fewer, more closely related tasks.

Improved Construction of Task Inventories

The results of this research indicated that occupational profile data from task inventories may be statistically analyzed to yield strategies for improving subsequent inventories. Factor analysis and cluster analysis alike proved useful for identifying aberrant tasks, combining task statements, and forming blocks of related tasks. The potential gain from such an approach appears greatest for technical, equipment-oriented occupations, although some benefit is likely to arise from analyzing other types of occupations as well.

CONCLUSIONS

1. Task statements in job task inventories are often not statistically independent, particularly for equipment-intensive duty categories.

2. Highly intercorrelated task statements or subtasks can be combined to form more inclusive, broader tasks. This procedure would simplify analysis and reduce administration time.

3. Respondents' pay grade and type of work center can affect task relationships with each other and must be considered when restructuring task statements.

4. The statistical methods demonstrated in this research are useful for forming blocks of intercorrelated tasks and identifying task statements that are poorly written or out of sequence.

RECOMMENDATIONS

It is recommended that military occupational analysts and others responsible for constructing task inventories of several hundred statements do the following:

1. Use the statistical methods demonstrated in this research to assess the uniqueness (statistical independence) of task statements.

2. To reduce the length of future occupational inventories, use the methods developed and demonstrated in this research to combine tasks into fewer, broader tasks or to eliminate unnecessary statements.

3. Where applicable, especially in equipment-intensive ratings, use one task statement for each system or component.

4. Use factor analysis or cluster analysis to develop labeled blocks of intercorrelated tasks and to form shorter, more specific duty categories.

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APPENDIX

INTERPRETATION OF CLUSTER ANALYSIS RESULTS FOR ITEM CLUSTERS

INTERPRETATION OF CLUSTER ANALYSIS RESULTS FOR ITEM CLUSTERS

Because cluster analysis is a relatively new tool for the analysis of occupational data, no standardized procedures for the interpretation of results are currently available. The most common procedure uses similarity indices and tree diagrams, routinely produced by cluster analysis computer programs, to define clusters. That procedure was applied to items, rather than job incumbents, in this analysis.

The interpretation of cluster analysis output using items is illustrated in Table A-1, the summary table output for the diving duty category of the SPECWAR officer survey. In the table, the first and last clusters always contain every variable, with intermediate clusters composed of two or more members. Thus, the first line of the table indicates that the first cluster begins at Item 1 and ends at Item 11 (at the bottom of the table), including all 15 tasks. The similarity value for this cluster (the entire matrix) is 70.40. The next cluster begins at Task 2 and ends at Task 1, containing two tasks with a similarity index of 87.11. The third cluster begins at Task 3 and ends at Task 4, while the fourth cluster begins at Task 4 and ends at Task 1, incorporating the first two smaller clusters. The similarity index for this new cluster is 82.69. The rest of the table continues similarly to describe the clusters of items and clusters of clusters until, at the last step, all 15 items are included in one cluster. These data are graphically presented in Figure A-1, which includes the tree diagram overlaid on the similarity matrix for the SPECWAR diving duty category and the scale used by BMDP to recode correlations to eliminate negative values.

Table A-1

Clustering Summary for SPECWAR Diving Duty Category
(N = 165)

Task Number	Boundary of Cluster	Number of Tasks in Cluster	Similarity When Cluster Formed
1	11	15	70.40
2	1	2	87.11
3	4	2	89.75
4	1	4	82.69
12	15	4	82.53
13	12	2	92.02
14	15	2	86.13
15	1	8	76.45
5	11	7	97.17
6	5	2	99.19
7	8	2	99.04
8	5	4	98.30
9	11	3	97.50
10	9	2	99.13
11	1	15	70.40

Results from Table A-1 and Figure A-1 were used together to define the task clusters illustrated in Figure A-2. More specifically, cluster boundaries were drawn at the intersection of horizontal and dashed lines (generated by the BMDP cluster analysis routine) in the diagram, provided all similarity values in the cluster met or exceeded the 70 level of the similarity value. In instances where several alternatives existed, the largest cluster was selected. Reading across the first row, it is evident that Task 1 could be placed in one of four clusters (as determined by four intersections of horizontal and diagonal lines). However, applying the above criteria, the boundary would be placed at Task 4. Figure A-2 is identical to Figure A-1, except that the clusters extracted have been highlighted. In this case, three clusters have been derived from the 15 items in the duty category. The clustering output is especially useful for identifying statements operating as subtasks, tasks that appear to be out of sequence or irrelevant, and groups of task statements that appear to be good candidates for the application of blocking.

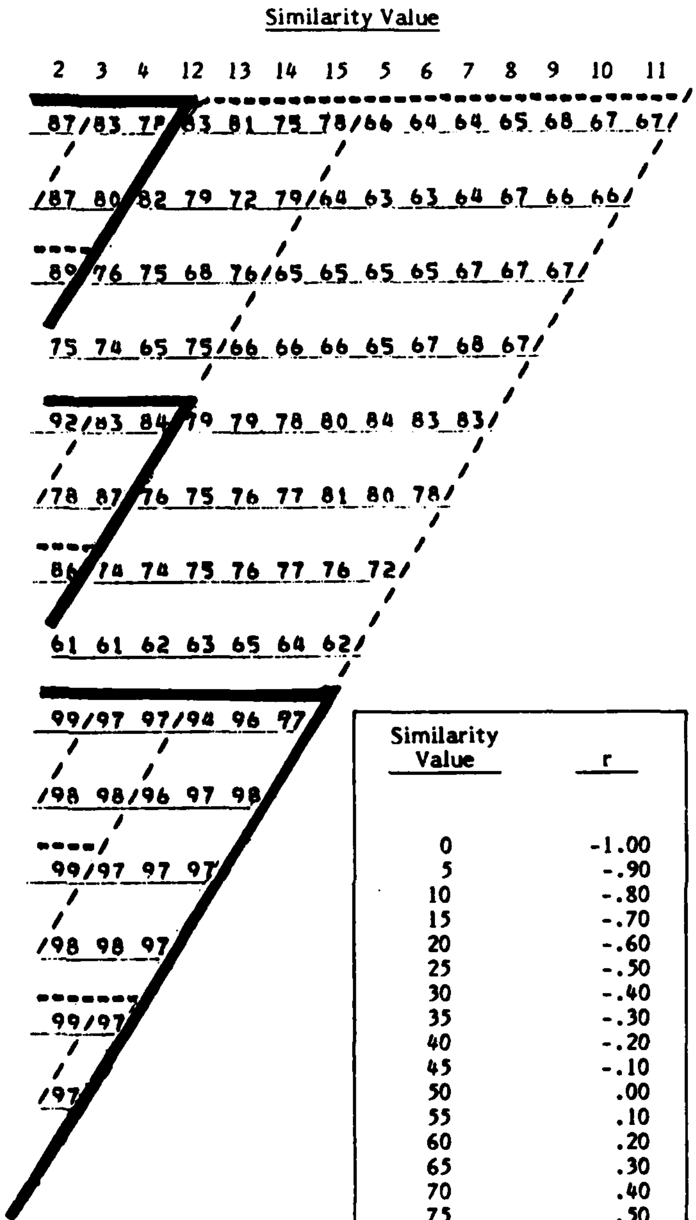
Task Statements	2	3	4	12	13	14	15	5	6	7	8	9	10	11
1. Schedule and coordinate unit training and requalification dives.	87	83	78	83	81	75	78	66	64	64	65	68	67	67
2. Maintain individual diving records.		87	80	82	79	72	79	64	63	63	64	67	66	66
3. Prepare and conduct diving operations briefings.			89	76	75	68	76	65	65	65	65	67	67	67
4. Perform the duties of a diving supervisor.				75	74	65	75	66	66	66	65	67	68	67
12. Administer diving PQS for team members.					92	83	84	79	79	78	80	84	83	83
13. Conduct investigations and prepare report re. diving accidents.						78	87	76	75	76	77	81	80	78
14. Supervise maintenance/repair of HP air systems, banks, compressors.							86	74	74	75	76	77	76	72
15. Supervise diving locker personnel.								61	61	62	63	65	64	62
5. Supervise repair of swimmer delivery vehicle (SDV) subsystems.									99	97	97	94	96	97
6. Supervise adjustment of mechanical components of SDV.										98	98	96	97	98
7. Supervise removal/replacement of mechanical components of SDV.											99	97	97	97
8. Supervise test inspection of electric or electronic components of SDV.												98	98	97
9. Supervise removal/replacement of electric or electronic components of SDV.													99	97
10. Supervise removal/replacement of components of life support system of SDV.														97
11. Supervise cleaning/changing/removal/replacement of SDV batteries.														

Similarity Value	r
0	-1.00
5	-.90
10	-.80
15	-.70
20	-.60
25	-.50
30	-.40
35	-.30
40	-.20
45	-.10
50	.00
55	.10
60	.20
65	.30
70	.40
75	.50
80	.60
85	.70
90	.80
95	.90

Figure A-1. Illustration of a tree diagram overlaid on the similarity matrix from the cluster analysis of the SPECWAR diving duty category.

Task Statements

1. Schedule and coordinate unit training and requalification dives.
2. Maintain individual diving records.
3. Prepare and conduct diving operations briefings.
4. Perform the duties of a diving supervisor.
12. Administer diving PQS for team members.
13. Conduct investigations and prepare report re. diving accidents.
14. Supervise maintenance/repair of HP air systems, banks, compressors.
15. Supervise diving locker personnel.
5. Supervise repair of swimmer delivery vehicle (SDV) subsystems.
6. Supervise adjustment of mechanical components of SDV.
7. Supervise removal/replacement of mechanical components of SDV.
8. Supervise test inspection of electric or electronic components of SDV.
9. Supervise removal/replacement of electric or electronic components of SDV.
10. Supervise removal/replacement of components of life support system of SDV.
11. Supervise cleaning/changing/removal/replacement of SDV batteries.



Similarity Value	r
0	-1.00
5	-.90
10	-.80
15	-.70
20	-.60
25	-.50
30	-.40
35	-.30
40	-.20
45	-.10
50	.00
55	.10
60	.20
65	.30
70	.40
75	.50
80	.60
85	.70
90	.80
95	.90

Figure A-2. Illustration of cluster boundaries for clusters extracted from the SPECWAR diving duty category.

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